Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] 1. A method for determining the vibration damping characteristics of an automotive brake structure, comprising the steps of:

resiliently mounting said brake structure to a stationary base;

applying broadband, random-frequency vibratory excitation to said brake structure;

measuring the vibration response of said brake structure during application of said random-frequency excitation, including responsive vibration occurring at not less than one modal frequency;

applying a confined bandwidth random-frequency vibratory excitation to said brake structure, with said confined bandwidth being selected to correspond to said at least one modal frequency;

measuring the vibration response of said brake structure during application of said confined bandwidth signal; and

using the measured vibration response of said brake structure to said confined bandwidth signal to calculate the damping value of said brake structure.

[c2] 2. A method according to Claim 1, wherein said broad-band random-frequency excitation ranges in frequency from 10Hz to 15kHz.

[c3] 3. A method according to Claim 1, wherein said brake structure is excited by a variable reluctance actuator.

[c4] 4. A method according to Claim 1, wherein said vibration response of said brake structure is measured by a non-contacting sensor system.

[c5] 5. A method according to Claim 4, wherein said non-contacting sensor system comprises a laser velocimeter.

[c6] 6. A method according to Claim 1, wherein the damping value of said brake structure is calculated as:

$$\eta = \frac{f_{+3dB} - f_{-3dB}}{f_{peak}}$$

where:

$f$peak = the center frequency of a modal vibration;

f+3dB = the frequency, higher than $f$peak, which corresponds to 3dB reduction in the magnitude of vibration; and

f-3dB = the frequency, lower than $f$peak, which corresponds to 3dB reduction in the magnitude of vibration.

[c7] 7. A method according to Claim 1, wherein said confined bandwidth excitation has a bandwidth of 200Hz-400Hz and a center frequency equal to said at least one modal frequency.

[c8] 8. A method for determining the vibration damping characteristics of an automotive brake structure, comprising the steps of:
resiliently mounting said brake structure to a stationary base;
applying a broadband random-frequency vibratory excitation to said brake structure by using a non-contacting actuator;
measuring the vibration response of said brake structure to said broadband random-frequency excitation by using a laser velocimeter, with said measurement including the measurement of vibratory response occurring at a plurality of modal frequencies during application of said vibratory excitation;
serially applying a plurality of confined bandwidth random-frequency vibratory excitations to said brake structure, with each of said confined bandwidth excitations having a center frequency corresponding to one of said modal frequencies;

measuring the vibration response of said brake structure during application of said confined bandwidth excitations; and

using the measured vibration response of said brake structure to said confined bandwidth excitations to calculate damping values for said brake structure at said plurality of modal frequencies.

[c9] 9. A method according to Claim 8, wherein said random-frequency excitation ranges in frequency from 10Hz to 15kHz.

[c10] 10. A method according to Claim 8, further comprising the step of determining the structural integrity of said brake structure by comparing a pattern of modal lines developed at a fixed frequency with a predetermined pattern of such modal lines.

[c11] 11. A method according to Claim 8, wherein said brake structure comprises a disc brake pad.

[c12] 12. A system for determining the vibration damping characteristics of an automotive component, comprising:

a broadband, random-frequency vibratory exciter for inducing vibration in said component;

a non-contacting vibration measuring device for determining the frequency response of said component dur-

ing said vibratory excitation, with said frequency response including a plurality of modal frequencies;
a confined bandwidth random-frequency vibratory exciter for inducing vibration in said component at frequencies corresponding to said plurality of modal frequencies; and
a controller for determining, for at least one of said modal frequencies, the vibration damping characteristic of said component as the ratio of the difference in the frequencies of the vibrations, at a predetermined off-peak magnitude, to the value of said modal frequency.

[c13] 13. A system according to Claim 12, wherein said processor determines said vibration damping characteristic at a plurality of modal frequencies.

[c14] 14. A system according to Claim 12, further comprising an variable temperature environmental chamber for housing said component, with said chamber having at least one port for accommodating said vibratory exciter and said vibration measuring device.